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Occurrence of the barnacle Tesseropora rosea (Krauss) (Thoracica, Balanomorpha, Tetraclitidae) in western Australian waters.

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Tesseropora rosea was originally described from one specimen collected at Algoa Bay, South Africa (Krauss 1848). Darwin (1854) recorded material from eastern Australia and, after examining the unique South African specimen commented (p. 335) 'There can be no doubt of the identify of the African and Australian specimens. It is a singular circumstance that the same species should occur in these two distant places, and, as far as at present known, not in the intermediate, more tropical coasts'. The species has not been collected either in South Africa, or on the 'intermediate more tropical coasts' since that time. However, as well as eastern Australia, the species is also known from Lord Howe Island and the Kermadec Islands (Endean *et al.* 1956a, 1956b; Foster 1978; Anderson & Anderson 1985).

In eastern Australia *T. rosea* occurs between lat. 19^{0}S and 38^0, and has never been recorded from western areas of the continent. The species occurs abundantly in exposed coastal areas and on flat rock platforms which are subjected to strong wave action, extending from between just above mean low water neap to mean high water neap tidal levels (Pope 1945; Dakin *et al.* 1948, 1953; Denley & Underwood 1979; Anderson & Buckle 1983; Anderson & Anderson 1985).

In 1986 three live specimens of *T. rosea* were collected on intertidal granitic rocks at Cottesloe, Western Australia, by Ms L.M. Marsh (WAM crustacean registration number WAM 2347-86). Since 1986 four isolated large individuals of *T. rosea* have also been observed at the South Groin and Success Harbour, Fremantle, W.A. The cirripede collection in the Western Australian Museum also includes three dry specimens of *T. rosea* collected at Garden Island and Cockburn Sound, W.A., in 1948 and 1969 (WAM 536-86, 775-86).

More than one zoogeographic hypothesis may be put forward to account for the occurrence of these isolated specimens of *T. rosea* in Western Australia. The competing hypotheses of natural oceanic dispersal versus man-aided transportation will be considered.

T. rosea is known for an odd disjunction (present in the Kermadec Islands but absent from New Zealand), showing that isolated populations do occur. The marine invertebrate fauna of southern Australian waters is not well known. Womersley & Edmonds (1958) pointed out the dearth of information on intertidal ecology and marine coastal zonation in western areas of the continent. An apparently disjunct distribution of a species in these southern areas may therefore merely reflect a limited collecting effort

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rather than the true natural geographic range of the species. In eastern Australia the most southerly record of *T. rosea* is Bastion Point, Malacoota, Victoria, 37°35'S, 149°45'E (Australian Museum, specimen no. P21147) and the most westerly record of the species is Inverloch, Victoria, 38°38'S, 134°44'E (Marine Research Group of Victoria 1984). No other records of *T. rosea* occurring in the waters of southern or south-western Australia are known until those contained in the present contribution. In a zoological survey of Adelaide beaches Johnston & Mawson (1946) did not record *T. rosea* and this species was not recorded from intertidal rock platforms at Kangaroo Island (Edmonds 1948), nor was it considered to be part of the South Australian marine fauna (Womersley and Edmonds 1952, 1958). During the past five years the Western Australian Museum has carried out a systematic survey of littoral barnacles in south-western Australia, between Cape Naturaliste (33°32'S, 115°01'E) and Esperance (33°52'S, 121°54'E). Collections were made in intertidal areas where *T. rosea* could be expected to occur, but the species was not obtained in these surveys.

Although *T. rosea* is not ecologically prevelant in Western Australia, the possibility that the species does occur in very low numbers cannot be disregarded. Its occurrence at Fremantle may represent the edge of an ecological range, or the establishment of, or conversely the demise of, a population. Fremantle lies within the latitudinal range of the species both in eastern Australia and the Kermadec Islands. The conspicuous absence of the temperate Australian cirripedes *Chamaesipho tasmanica, Catomerus polymerus* and *Chthamalus antennatus* from Western Australian shores has been explained, in part, by a lack of larval recruitment, due to prevailing along-shore currents flowing from west to east in southern Australian areas (Jones, in press). It is unlikely, therefore, that the Fremantle specimens of *T. rosea* represent outliers of the eastern states population, dispersed by along-shore currents.

The second hypothesis considers man-aided dispersal. Fremantle is a major port area and Garden Island and the adjacent Cockburn Sound are shipping and anchorage areas. It would be possible for adults of *T. rosea* to be transported as a fouling organism on ships' hulls, or their larvae transported in water-intake ducts and chambers, etc. The ship-aided dispersal of the Australasian barnacle *Elminius modestus* Darwin into Europe at the beginning of World War II and its more recent spread along Atlantic shores is well documented (Bishop 1947, 1951; Southward & Crisp 1963). However, the Tetraclitidae in general are not considered to be fouling organisms. The fact that *T. rosea* has never been recorded from wooden substrata (Pope 1945; Daniel 1972) adds further weight to the argument that the species is unlikely to be a fouler and, therefore, unlikely to be introduced in this manner. Furthermore, due to faster boats, shorter harbour berthing periods and the development of antifouling technology the likelihood of fouling as a dispersal mechanism is becoming less (Williams *et al.* 1982; Carlton 1985).

Studies on the ballast water of bulk cargo vessels have shown that live organisms can survive transportation and, when discharged with the ballast water, can settle and establish viable populations (Carlton 1985). Barnacle larvae have been commonly recorded as having survived transport in ballast water (Howarth 1981; Carlton *et al.* 1982) and Carlton (1985) has suggested that ballast water may have played a role in the

dispersal of certain barnacles — viz. *Balanus eburneus* Gould, *B. subalbidus* Henry. Ballast water is frequently discharged within the limits of the harbour at Fremantle, with some exchange occurring before entry to the harbour (Hutchings *et al.* 1987). Therefore, ballast water transport could be the dispersal agent for the introduction of barnacle nauplii and cyprids into the waters of Fremantle harbour, Cockburn Sound, Garden Island and Perth metropolitan beaches. Whatever the means of introduction and the dispersal mechanism, *T. rosea* appears to have become established, albeit in small numbers, in the Fremantle area since 1948.

Breeding populations of introduced molluscan species in the Swan River estuary and Cockburn Sound are known (Wilson & Kendrick 1968; Slack-Smith & Brearley 1987) and ballast water transportation or ship fouling have been postulated to explain their presence in Western Australia (Carlton 1985; Hutchings *et al.* 1987; Slack-Smith & Brearley 1987). In the past 15 to 20 years over a dozen exotic marine species have been detected in Western Australian waters (Hutchings *et al.* 1987, Table 1). The majority of these species occur in the Swan River estuary and for a number of these introductions ballast water has been suggested as a dispersal mechanism. Williams *et al.* (1982) stated that in Australia there are no treatment facilities for ballast water or mud, the method of dispersal being overboard discharge. These authors also predicted that, since over one-half of the total ballast water dumped in Australia is dumped in Western Australia, this state must be at most risk to introductions via ballast water. The increase in the number of exotic species in Western Australian waters should be monitored since some of these species have the potential to become pests, or to exclude native species by competition.

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